Appendix D
Mechanical and Electrical Report

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PE
GROUP

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First Unitarian Society of Plainfield

Mechanical and Electrical Systems

HVAC

Existing System

Heating- The building is heated by four gas fired boilers, located in the basement of the school wing *(Fig. H-1)*. Distribution is by a primary/secondary pumped hydronic system. There are nine secondary pumps *(Fig. H-2)*. The boiler is vented into a masonry chimney.

The main circulating pump and the secondary pumps are located in the same boiler room. Terminal devices are largely cast iron baseboard in the school wing. Heating in the Parish Hall is by two hydronic coils in the ductwork serving the space *(Fig. H-3)*. There is also a steam boiler located in the Sanctuary basement *(Fig. H-4)* which serves steam radiators *(Fig. H-5)* in the Parish Hall. This system is used as backup if the main system is non-operational.

Heating in the rooms surrounding the Parish Hall is by fin tube radiation.

The Sanctuary is heated by hydronic coils located in the discharge ductwork from three air handling units in the Sanctuary basement.

A disassembled earlier boiler is still in the basement. The heating system formerly was oil fired; the oil storage tank is said to have been properly de-commissioned.

Cooling- The school wing first floor is cooled by window or through wall air conditioning units. The basement of this wing has no mechanical cooling.

The Steven's Room is cooled by a ductless split system cooling unit with the evaporator unit located over the doorway.

The Parish Hall is cooled by two split system direct expansion units. The condensing units are located outdoors behind the Parish Hall stage *(Fig. H-6)*. The evaporator coils are located outdoors downstream of the fan section *(Fig. H-7)*. Air is distributed to the space via exposed ductwork *(Fig. H-8)*

The Sanctuary is cooled by three split system direct expansion units with outdoor evaporators located behind the Stage *(Fig. H-6)* and indoor blower coils in the basement *(Fig. H-9).* These units are ducted to floor supply and return grilles in the Sanctuary *(Fig. H-10).*

The ministers office is cooled by a window type air conditioning unit which vents into a fireplace *(Fig. H-11)*.

The Susan B. Anthony Room is not provided with mechanical cooling.

Ventilation- Ventilation is generally provided by operable doors and windows. There are a few ceiling propeller fans throughout the building.

Bathrooms are generally provided with mechanical exhaust; one bathroom in the school wing uses an operable window for ventilation.

The kitchen is provided with a commercial type exhaust hood with fire suppression *(Fig. H-12).* The kitchen exhaust fan is located on the roof above *(Fig. H-13).*

Combustion air is provided for the hydronic boilers by an open basement window *(Fig. H-14)*. Combustion air for the steam boiler is provided by infiltration.

The attic above the school wing has a ventilation fan and air intake opening.

Equipment-

Hydronic Boilers- Three of the boilers are Weil McLain Model HEII, 167 MBH gas input, 119 MBH IBR output. The fourth boiler is Weil McLain Model CGI6PINS2, 167 MBH gas input, 122 MBH IBR output.

The steam boiler serving the Parish Hall is an H.B. Smith 2000 Mills.

Condensing Units, Sanctuary and Parish Hall- York Model H4DB060SO6A, 5 ton capacity.

Cooling Unit, Stevens Room- Sanyo Model KS3012W.

Condition of System

General- A copy of a Building Needs Planning Report (BNPR) dated April 2007 was given to PEG at the time of the visit. This study incorporates appropriate recommendations from the report.

Heating- The hydronic boilers are approximately 20 years old and appear to be in good condition. The system was said to experience occasional flame failures due to faulty igniters and draft inducer, but this is said to have been corrected.

The thermostats which control the heating system in the school wing are manual type without automatic time clock control. Several thermostats were missing components at the time of the survey *(Fig. H-15).*

The Parish Hall vestibule convective heater is said to provide insufficient heating during times of heavy use, when the doors are opened repeatedly during cold weather.

The diffusers in the exposed ductwork in the Parish Hall are said to provide poor air circulation in heating mode since they are oriented horizontally and do not force the warm air down to ground level.

The rooms adjacent to the Parish Hall experience discomfort due to insufficient heating control.

Heating in the Ministers Office from the hydronic system is inadequate and an electric heater is used to improve comfort. This space is said to be on the same control zone as the Sanctuary which does not permit for proper heating.

Ventilation- The combustion air opening for the hydronic boilers does not meet current code requirements. The screened opening was partially clogged with leaves at the time of our visit, further restricting fresh air flow. Insufficient combustion air may cause carbon monoxide production.

Cooling- No problems have been noted concerning cooling in the Sanctuary and Parish Hall. The equipment is approximately 5 years old and appears to be in good condition.

Window type air conditioning units are generally not considered an optimal means of cooling. These type of units are noisy, provide poor air distribution and are relatively inefficient.

The Ministers Office is cooled by a window type cooling unit vented into the chimney which is not an acceptable installation.

Recommendations

The combustion air supply for the school boilers should be upgraded to conform with current code requirements. This would either be via two openings in the outside wall with motorized dampers or a supply air fan interlocked with each boiler.

Install a forced air heater in the vestibule to replace the convector so as to provide greater heating capability.

Replace the heating system controls for the classrooms with systems which allow for automatic setback such as local time clock digital thermostats. We are told that replacement of these thermostats with time clock type units is in progress.

Rotate the supply registers in the Parish Hall ductwork to better distribute warm air in the space.

Provide separate zones of control for heating in three offices adjoining the Parish Hall. This would consist of a new zone pump in the boiler room and zone control valves for each of the offices. Piping in the basement below would be rearranged to allow for individual zone control.

The heating for the Ministers office should be arranged to allow for its own zone of control. The window air conditioning unit installed in the fireplace should be removed and replaced with a small split system heat pump unit which would provide both heating and cooling.

If the classrooms are to be occupied on a regular basis, consideration should be given to providing cooling from a central system. A recommended system would be a split system direct expansion cooling system such as Daiken VRV or Mitsubishi CitiMulti. The indoor units could simply be wall mounted or, preferably, located in the attic and supplied to each space via ductwork and ceiling grilles.

Provide cooling for the Susan B. Anthony Room. This would ideally be a ductless split system, such as that manufactured by Sanyo or Mitsubishi.

The BNPR suggests that a direct digital controls (DDC) system be installed to control all of the HVAC in the building. This would afford benefits in reduced energy consumption, better maintenance and remote notification of equipment failures. This system could also perform other functions, such as lighting control.

If the main heating system would be made more reliable, the steam radiators and boiler can be removed, reducing the maintenance burden.

The BNPR recommends investigation of alternative means of cooling and heating, such as ground source heat pumps. These systems would lower energy costs, but would require a substantial investment. Since many of the systems in the building are fairly new, a better use of limited funds would be to improve controls for existing equipment so that systems are only operated when needed. Wholesale system changes should probably wait until equipment reaches the age when replacement is required. However, investigation of alternative systems, such as geothermal, can begin earlier.

Fig. H-1- Hydronic boilers.

Fig. H-2- Circulating pumps

Fig. H-3- Parish Hall heating coils

Fig. H-4- Steam boiler

Fig. H-5- Steam radiator.

Fig. H-6- Condensing units

Fig. H-7- Parish Hall air handling units.

Fig. H-8- Parish Hall ductwork

Fig. H-9- Sanctuary air handling unit.

Fig. H-10- Sanctuary floor grille.

Fig. H-11- Ministers office cooling unit.

Fig. H-12- Kitchen exhaust hood.

Fig. H-13- Kitchen exhaust fan.

Fig. H-14- Boiler room combustion air opening.

Fig. H-15- Damaged school wing thermostats.

ELECTRICAL

Existing System

Service- The electric service is located in the basement under the sanctuary (*Fig. E-1*) The service is a two pole service providing 120/240 volts. The electrical meter and current transformer cabinet are located at the service entry point.

A 200 ampere circuit breaker disconnect is also attached to the service. The disconnect serves the air conditioning panel on the stage.

The original service was replaced as part of an HVAC upgrade. The original service was disconnected from the main service panel (MSP). The MSP was reconnected to the new service. This panel is a 40 pole, 200 ampere, Square D panel with a pull out main disconnect. (*Fig. E-2*)

Distribution- The MSP contains the distribution circuit breakers for the electrical panels located throughout the building. There is an open knockout in the side of the panel that should be sealed. (*Fig. E-3*)

A 100 ampere, 2 pole circuit breaker serves the stage panel. This panel is a 100 ampere, 20 pole panel manufactured by GE. (*Fig. E-4*)

A 100 ampere, 2 pole circuit breaker serves the panel in the Steven's boiler room. This panel is a 125 ampere, 24 pole, load center. (*Fig. E-5*)

A 100 ampere, 2 pole circuit breaker serves the panel in the entrance vestibule near the kitchen. This panel is a 125 ampere, 24 pole, GE load center. (*Fig. E-6*)

A 60 ampere, 2 pole circuit breaker serves the panel in the Steven's first floor closet. This panel is a 60 ampere, 12 pole, GE load center. The load center appears too small for this area. (*Fig. E-7*)

Receptacles- The majority of the receptacles were of the grounded style.

Basement receptacles are required to have ground fault protection.

Wiring- The wiring within the panels and exposed in the basement, was generally in fair condition.

These circuits powered grounded electrical outlets.

Non-metallic jacketed wiring (NM cable) is not permitted for use in non-residential building unless concealed by a 15 minute fire rated assembly. There is a significant amount of this type of cable installed exposed in the building. *(Fig. E-8)*

The majority of the wiring the Sanctuary wing is older style cable. *(Fig. E-9)*

There is a lack of circuits within the Classroom wing.

A conduit is attached to a gas pipe in the basement and is a code violation. *(Fig. E-10)*

Low voltage wiring is run exposed on and trough walls without protection.

Lighting- The existing lighting consists of various, incandescent and fluorescent fixtures. (*Fig. E-4).*

The lenses in the classroom wing are severely yellowed by age and could be losing 20% of there rated light output.

Emergency lighting is insufficient within the building and at the exterior means of egress.

The stage lighting in the Parish Hall is a collection of miscellaneous fixtures and types. It does not appear to be the most effective way of lighting a stage.

Fire Alarm System- The fire alarm system consists of Fire-Lite MS 5012 alarm panel with limited smoke detector coverage and manual pull stations. The smoke detector coverage is insufficient for proper protection of this building. *(Fig. E-11)*

Recommendations

Service- The electric service is adequate for the current usage of the building. The size of the service will have to be reviewed if air conditioning is added to the building. The knockout should be sealed in panel MSP.

Wiring- All older wiring should be replaced. All non-metallic jacketed wiring should be replaced.

Low voltage wiring should be protected by surface metal raceway or conduits.

Receptacles- All non-grounded receptacles should be replaced. Ground fault circuit interrupting receptacles should be added within six feet of sinks, at the exterior of the building and in the basement.

Lighting- Lighting in the classroom wing should be replaced in the corridors, classrooms and basement.

Emergency lighting should be replaced and augmented as required by code.

The stage lighting should be replaced.

Incandescent lighting fixtures should be replaced with energy efficient fixtures with integral ballasts.

Fire Alarm System- A fire alarm and detection system should be expanded to cover the entire building adequately. Additional alarm devices should be added to the classrooms.

Fig. E1- Service Meter, CT Cabinet and AC Disconnect

Fig. E2 –Main Service Panelboard (MSP)

Fig. E3- Open knockout in MSP

Fig. E4- Stage Panel

Fig. E5 – Boiler Room Panel –School Wing

Fig. E6 – Entrance Panel

Fig. E7 – School Wing Closet Panel

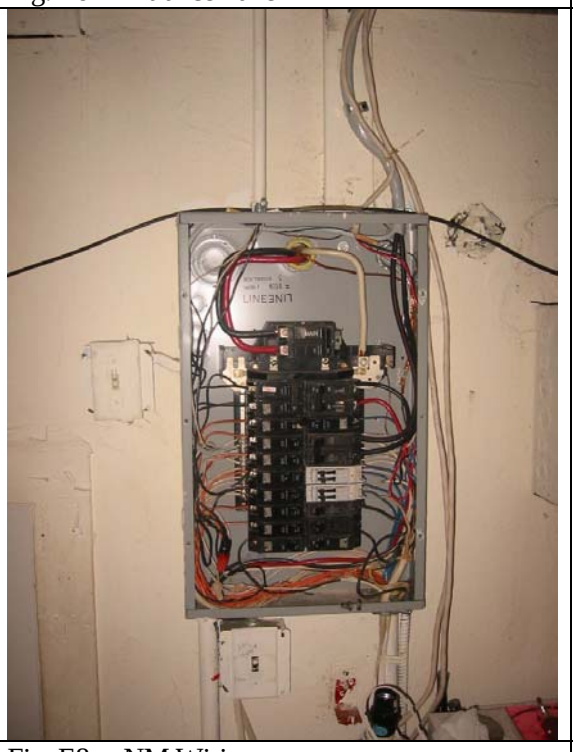

Fig. E8 – NM Wiring

Fig. E9 – Old Wiring in Sanctuary Basement

Fig. E10 – Conduit attached to Gas Pipe

Fig. E11 – Fire Alarm Panel

Domestic Cold Water- A 1" domestic water service enters the building in the basement from Park Avenue, equipped with a ½" water meter (*Fig. P-1*). The visible water distribution piping is copper.

Domestic Hot Water- Hot water is provided by (2) gas fired hot water heaters. The first water heater serves the kitchen and toilet rooms at the sanctuary. This water is Rheem Model 44x40-2, 39 Gallon capacity, 57.7 MBH Natural Gas input (*Fig P-17*). The second water heater serves the classroom wing of the building. This water heater is GE Model GG30T6A, 30 Gallon capacity, 32 MBH Natural Gas input (*Fig. P-14*).

Natural Gas- A 1-1/4" natural gas service is stubbed into the sanctuary basement from Park Avenue to (2) gas meters (*Fig. P-1*). The natural gas serves the boilers, water heaters, and kitchen stove. In the classroom wing electrical conduit is hung from natural gas piping by duct tape.

Sanitary Drainage- The sanitary system is made up of cast iron hub and spigot pipe. A 4 inch sanitary main exits the building below grade at the front of the sanctuary and discharges by gravity to the city sewer system at Park Avenue (*Fig. P-2*). A second 4 inch sanitary main exits the building at the back of the classroom wing below grade and discharge by gravity to the city sewer system (*Fig. P-12*).

Storm Drainage- Storm drainage is comprised of outside gutters and downspouts discharging to grade (*Fig. P-18*). At the basement level, the window wells are each provided with a drain that runs through the basement (*Fig. P-15*).

Plumbing Fixtures- Toilet fixtures installed in each of several bathrooms throughout the building are made of vitreous china. Water closets are floor mounted. Lavatories are wall hung and counter top. There are some abandoned fixtures in the basement area below the sanctuary. One of the classrooms contains a child size water closet (*Fig. P-16*). The water closets located at the sanctuary are relatively new and the water closets are pressure assisted (*Fig. P-7*). The water closets in the classroom area are older except for one in the boys toilet room, these water closets are all standard tank flush fixtures (*Fig. P-9*). There is a wall hung urinal in both the Men's room at the sanctuary and in the Boy's room in the classroom area. In the classroom wing, there is a kitchen area with a residential type stainless steel countertop sink and adjacent single bowl without water supply (*Fig. P-11*). The main kitchen area near the sanctuary is equipped with a commercial triple bowl sink with drain boards on each side (*Fig. P-3*). The left most drain bowl is equipped with a garbage disposal unit. The sink is not equipped with a grease interceptor. There is also a commercial under counter dishwasher located underneath the left side drain board.

Fire Suppression- The fire suppression system consists of (2) limited area sprinkler heads in the boiler room. A chemical fire suppression system is provided for the grease exhaust hood located in the kitchen (*Fig. P-4, P-5*). The remainder of the building is not equipped with a fire suppression system. The attic space above the classroom wing is being used for combustible storage; this use is not code compliant since there appears to be neither a fire suppression system nor a 1-hour fire separation in this area.

Condition of System

General- The plumbing systems generally appear to be in good condition. A copy of a Building Needs Planning Report (BNPR) dated April 2007 was given to PEG at the time of the visit. This study incorporates appropriate recommendations from the report.

Domestic Cold Water- A visual inspection indicates that the copper appears to be in good condition.

Domestic Hot Water- The piping appears to be in good condition. Water heaters are fairly new and appear to be in good condition. The water supply for the kitchen fixtures is on an exterior wall and a circulator was provided to prevent freezing, this is reportedly working as desired.

Natural Gas- The piping appears to be in good condition.

Sanitary Piping- Cast iron sanitary piping appears to be in good condition. The sanitary system is reported to be subject to periodic blockages due to misuse by various building occupants. The portion of the sanitary system serving the kitchen at the sanctuary is also subject to being clogged by grease.

Storm Drainage- There are a few locations where the down spouts have been disconnected. Also there are some reported problems with storm water entering the basement.

Plumbing Fixtures- Toilet fixtures appear to be of good quality and in good condition. The fixtures in the sanctuary toilet rooms are a relatively new and in good condition, they appear to provide ADA compliance. The toilet fixtures in the classroom wing are older but appear to be in relatively good condition however the tank lid of one of the water closets in the Girls room is cracked. These toilet fixtures are not ADA compliant.

The kitchen fixtures at the sanctuary are relatively new and appear to be in good condition. Since the triple bowl sink is not equipped with a grease interceptor, it is not compliant with current code requirements. The garbage disposal unit was replaced earlier this year in July.

The kitchen fixtures in the classroom wing appear to be in good condition.

Fire Suppression- The limited amount of sprinkler piping appears to be in good condition. The fire suppression system for the kitchen exhaust hood is relatively new and in good operating condition.

Recommendations

Domestic Cold Water- Service appears to be adequate. However, any proposed architectural layout changes must be reviewed to confirm adequacy. Replace and/or add insulation to piping that may be located in areas subject to freezing.

Domestic Hot Water- Service appears to be adequate. However, any proposed architectural layout changes must be reviewed to confirm adequacy. Replace and/or add insulation to piping that may be located in areas subject to freezing.

Natural Gas- Service appears to be adequate. However, any proposed changes to the architectural layout, HVAC systems, and kitchen equipment must be reviewed to confirm adequacy. Electrical conduit should be properly re-hung independent of gas piping.

Sanitary Piping- Replace any worn drain traps under fixtures and upgrade lavatory waste and water piping to comply with ADA regulations as required. Repair or replace piping at leaks as needed. The sanitary main should be internally inspected to assess its condition. It would be recommended to provide a grease interceptor for the triple bowl kitchen sink but not required unless the kitchen area is renovated.

Storm Drainage- Where required reconnect and/or extend storm drainage away from building, replace worn and broken splash blocks, some minor site work may be required to insure the storm drainage flows away from the building. It was also suggested in the Building Needs Planning Committee Report – April 2007 to investigate connecting the building storm drainage to the city drainage system, evaluation of this item will require assistance from a civil engineer for the collection and routing of the storm drainage along with appropriate grading of the site.

The existing sump pump in the basement should be inspected to verify it is in proper working order and if necessary replaced with new. It may be beneficial to provide the sump pump with an emergency battery back-up power supply as suggested in the Building Needs Planning Committee Report – April 2007 this system could be applied with a new or existing pump.

Plumbing Fixtures- Provide new ADA fixtures as required. Replace cracked water closet lid in Girls toilet room.

Fire Suppression- Depending on the extent and location of any renovation work or the use group and occupancy of spaces either a full or partial sprinkler system could be required to be installed. The chemical fire suppression

system for the kitchen exhaust hood and range should be inspected to verify it is in proper working order and any deficiencies corrected as necessary.

Fig. P-1- Domestic Water & Natural Gas Services

Fig. P-2- Sanitary Service Exit To Park Ave

Fig. P-3- Kitchen with Commercial Equipment

Fig. P-4- Exhaust Hood Controls & Pull Station

Fig. P-5- Gas Solenoid Valve To Range

Fig. P-6- Exhaust Hood Fire Suppression

Fig. P-7- Typical Water Closets At Sanctuary

Fig.P-8- Typical Lavs At Sanctuary

Fig. P-9- Typical Water Closet In Classroom Wing

Fig. P-10- Typical Lav In Classroom Wing

Fig. P-11- Kitchen Sink In Classroom Wing

Fig. P-12- Sanitary Service Entrance In Classroom Wing

Fig. P-13- Sump Pit In Classroom Wing

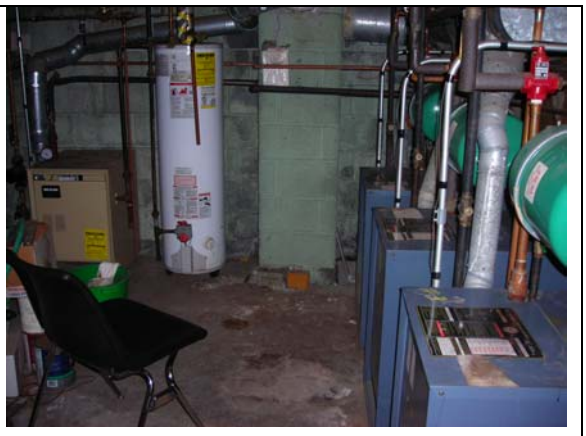

Fig. P-14- Water Heater in Boiler Room

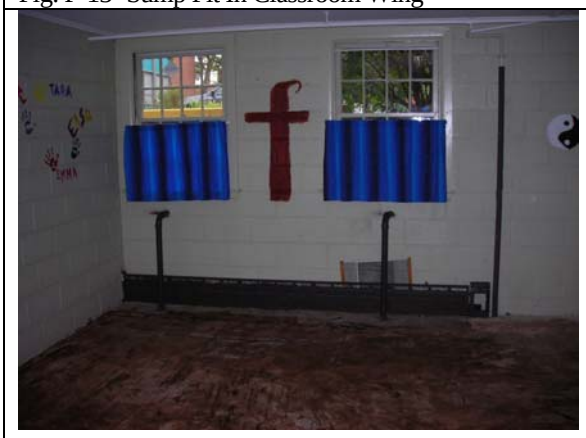

Fig. P-15- Window Well Drains In Basement

Fig. P-16- Child Size Water Closet

	
Fig. P-17- Water Heater & Steam Boiler	Fig. P-18- Storm Drainage At Back Of Building